

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
10 February 2005 (10.02.2005)

PCT

(10) International Publication Number  
**WO 2005/013443 A1**

(51) International Patent Classification<sup>7</sup>: **H01S 3/063,**  
**G02B 6/10**

(21) International Application Number:  
**PCT/GB2004/003190**

(22) International Filing Date: **23 July 2004 (23.07.2004)**

(25) Filing Language: **English**

(26) Publication Language: **English**

(30) Priority Data:  
**0317530.4** **26 July 2003 (26.07.2003)** **GB**

(71) Applicant (for all designated States except US): **QINETIQ LIMITED [GB/GB];** 85 Buckingham Gate, London SW1E 6PD (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **JENKINS, Richard, M. [GB/GB];** QinetiQ Limited, Malvern Technology Centre, Room PA109, St Andrew's Road, Malvern, Worcestershire WR14 3PS (GB). **MCNIE, Mark, E. [GB/GB];** QinetiQ Limited, Malvern Technology Centre, Room

**B9A4, St Andrew's Road, Malvern, Worcestershire WR14 3PS (GB). MCQUILLIAN, James [GB/GB];** QinetiQ Limited, Malvern Technology Centre, Room DX101A, St Andrews Road, Malvern, Worcestershire WR14 3PS (GB). **STACEY, Craig, D. [GB/GB];** QinetiQ Limited, Malvern Technology Centre, Room PA110, St Andrew's Road, Malvern, Worcestershire WR14 3PS (GB).

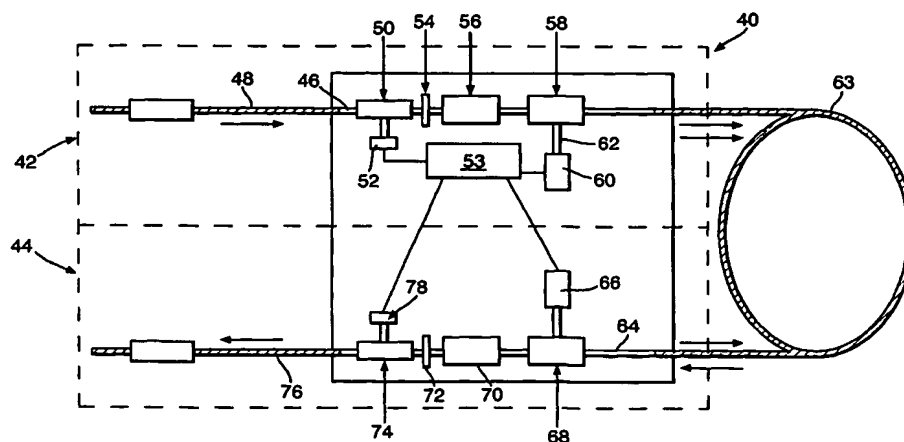
(74) Agent: **DUNN, Paul, E.;** QinetiQ Ltd, IP Formalities, Cody Technology Park, A4 Building, Room G016, Ively Road, Farnborough, Hampshire GU14 0LX (GB).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

[Continued on next page]

(54) Title: OPTICAL AMPLIFIER



(57) Abstract: Optical circuits for optical amplifier input and output stages are described. The input stage circuit (42) comprises a first optical waveguide (46) for carrying a signal beam to be amplified, a second optical waveguide (62) for carrying a pump beam, a beam combining means (58) optically coupled to the first and second optical waveguides (46, 62) for producing a combined signal/pump beam, and means for optically coupling the combined signal/pump beam into an amplifying optical fibre (63). The output stage circuit (44) comprises a first output optical waveguide (64), an optical fibre attachment means arranged to receive an amplifying optical fibre (63) and an optical fibre attachment means arranged to receive an output optical fibre (76) wherein light from the amplifying optical fibre (63) is optically coupled to the output optical fibre (76) via the first output optical waveguide (64). The first and second optical waveguides (46, 62) and the first output optical waveguide (64) are hollow core optical waveguides formed as channels in a substrate. A fibre amplifier, in particular an erbium doped fibre amplifier, comprising such optical circuits is also described.



WO 2005/013443 A1



GM, KI, LS, MW, MZ, NA, SD, SI, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NI, SN, TD, TG).

**Published:**

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

**Declaration under Rule 4.17:**

- of inventorship (Rule 4.17(iv)) for US only

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*